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Jones et al.

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(54) **MEMORY MODULE WHICH INCLUDES A FORM FACTOR CONNECTOR**

(75) Inventors: **Larry Lawson Jones**, Palo Alto, CA (US); **Sreenath Mambakkam**, San Jose, CA (US); **Arockiyaswamy Venkidu**, Menlo Park, CA (US)

(73) Assignee: **MCM Portfolio LLC**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

(63) Continuation of application No. 10/063,021, filed on Mar. 12, 2002, now Pat. No. 7,252,240, which is a continuation-in-part of application No. 09/610,904, filed on Jul. 6, 2000, now Pat. No. 6,438,638.

(51) **Int. Cl.**
G06K 19/06 (2006.01)

(52) **U.S. Cl.** **235/492**; 235/451; 361/737; 439/630

(58) **Field of Classification Search** 235/492, 235/451, 380, 486; 361/735–737; 439/630, 439/638

See application file for complete search history.

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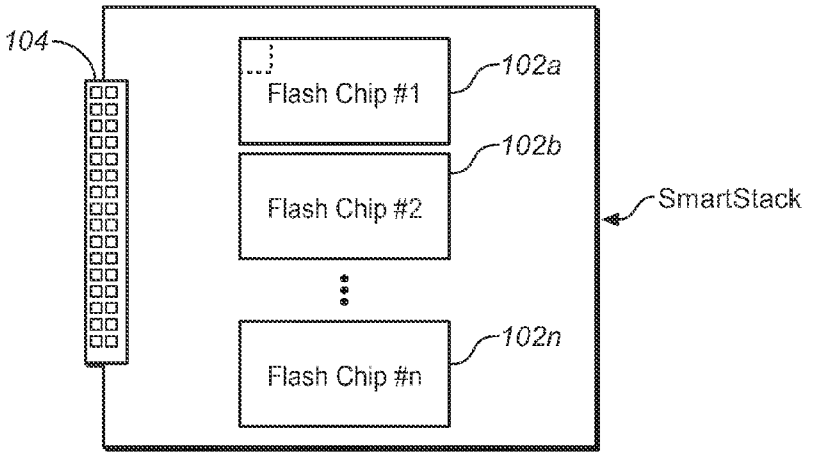
Primary Examiner—Ahshik Kim
(74) *Attorney, Agent, or Firm*—Greenberg Traurig, LLP

(57) **ABSTRACT**

A plurality of flash (solid state) media coupled to a single form factor connector to provide a module, i.e., referred to as a SmartStack module, that can be coupled directly to a device with a SmartStack module controller. The SmartStack module does not include a controller and is controlled from the host side. The form factor connector would typically be a CompactFlash (CF) form factor or some other form factor used in a variety of devices. The SmartStack memory module in a preferred embodiment includes a write protect switch that prevents certain portions of the memory within the SmartStack module from being written to. In addition, a portion of the flash memory will be allocated to the secure area for storing information to implement various forms of security. Another portion of the flash memory is allocated to store optional biometric information such as a user's fingerprint or retinal scan information, etc. In a preferred embodiment, the SmartStack module is a flash memory card in a CF Type I or II format; however, the card will not be compatible with standard CF readers, but will be compatible with SmartStack readers. Larger memory sizes will be available as larger flash memory chips become available.

17 Claims, 5 Drawing Sheets



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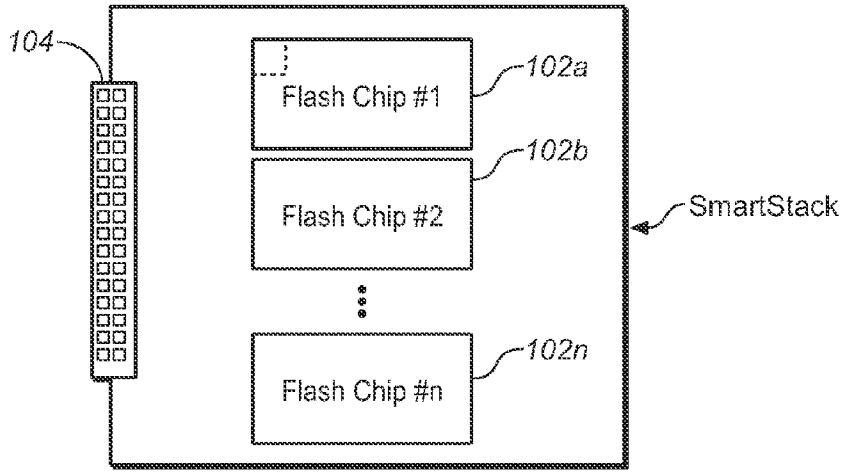
104
Flash Chip #1
102a
Flash Chip #2
102b
SmartStack
Flash Chip #n
102n

FIG. 1

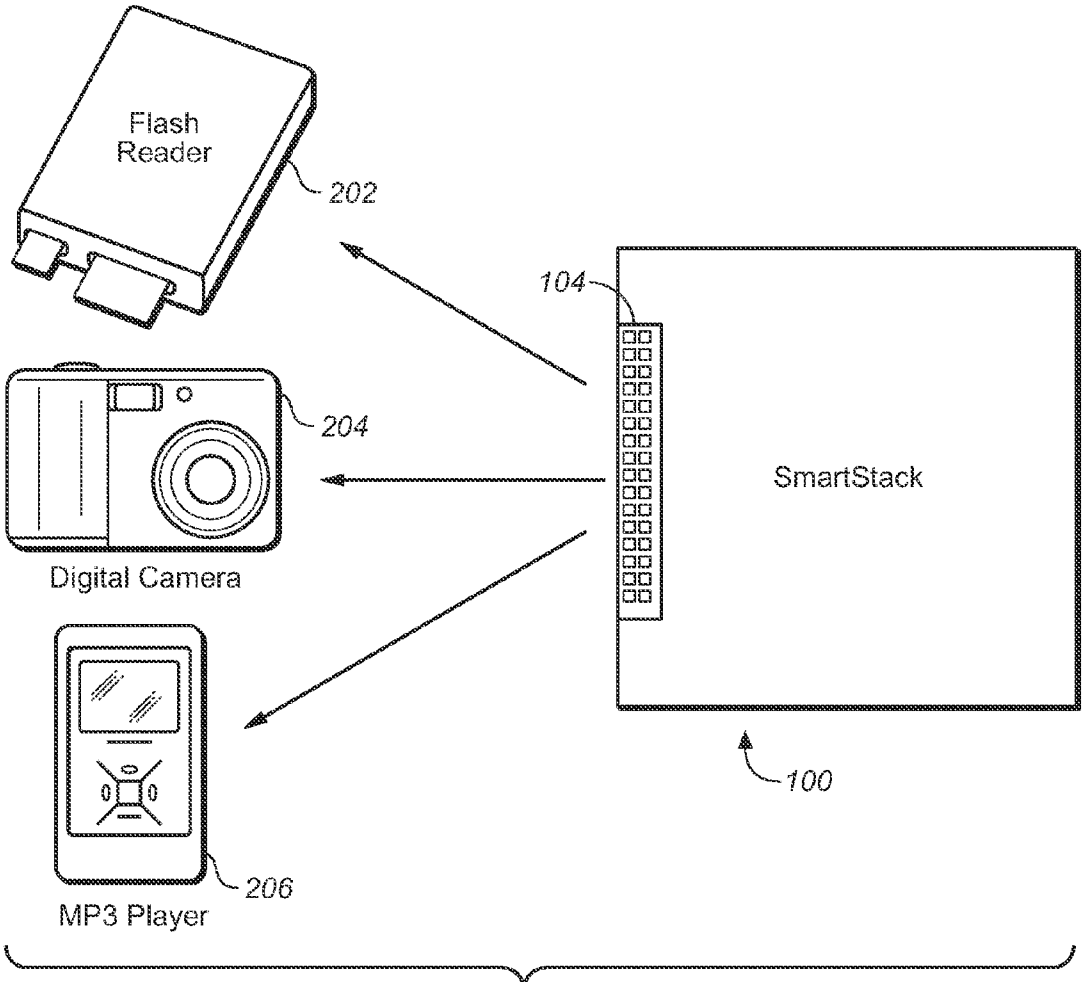
Flash Reader
202
104
204
SmartStack
Digital Camera
100
206
MP3 Player

FIG. 2

Media Type	CE1	CE2	A3	A5	A6	CD1	CD2
CompactFlash	1	1	1	1	1	0	0
Memory Stick	1	0	1	1	1	0	0
MMC/ SD Card	0	1	1	1	1	0	X
SmartStack NAND	0	0	0	0	0	0	0
SmartStack NOR	0	0	1	0	0	0	0
Reserved	0	0	0	1	0	0	0
Reserved	0	0	1	1	0	0	0
Reserved	0	0	0	0	1	0	0
Reserved	0	0	1	0	1	0	0
Reserved	0	0	0	1	1	0	0
Smart Media	0	0	1	1	1	0	0

FIG. 3

S[3:0]	Flash Chip
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9
9	10
A	11
B	12

FIG. 4

Pin	CompactFlash Signal	SmartStack Signal
14	A6	S0
7	-CE1	S1
32	-CE2	S2
20	A0	S3

FIG. 4A

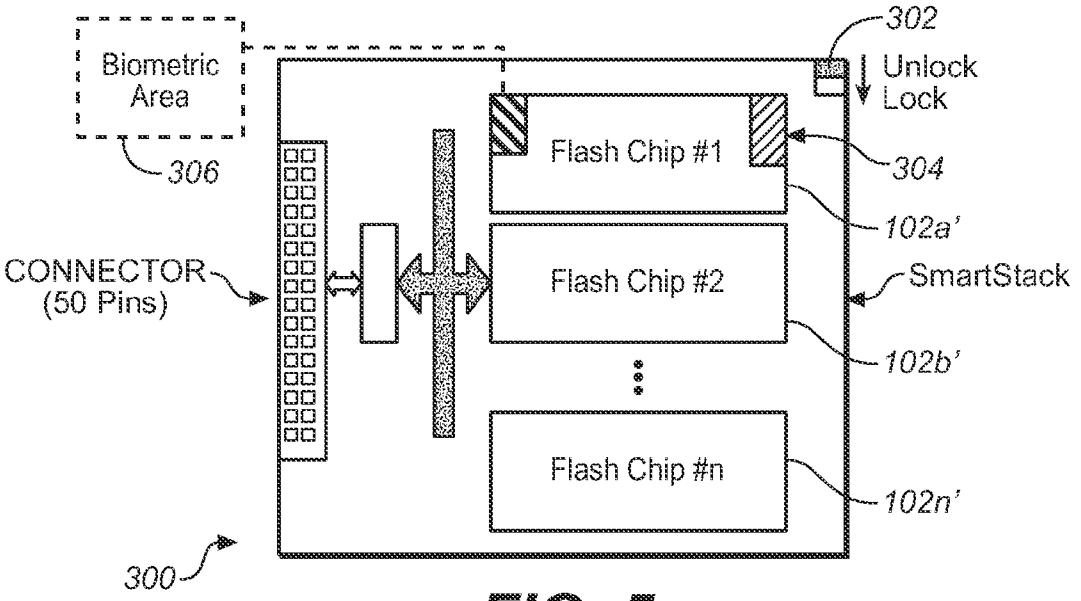

FIG. 5

Byte 0	Byte 1	Byte 2	Byte 3	Description
C3	B6	00	Xx	Reserved
C3	B6	01	AAH	Secure area starts here. If Byte 3 is AA, this is the last block, else it is 00 to denote a continuation in the next block.
C3	B6	02	AAH	Secure area ends here.
C3	B6	03	AAH	Biometric area starts here. If Byte 3 is AA, this is the last block, else it is 00.
C3	B6	04	AAH	Biometric area ends here.
C3	B6	05-54H	Xx	Reserved
C3	B6	55H	Xx	Start of Firmware block, fw is < 16K. If Byte 3 is 00, then there are more blocks to follow.
C3	B6	55H-A9H	Xx	Reserved
C3	B6	AAH	AAH	End of Firmware block. Byte 3 is AA to denote end block.
C3	B6	ABH-FEH	Xx	Reserved
C3	B6	FFH	FF	Blank Block

FIG. 6

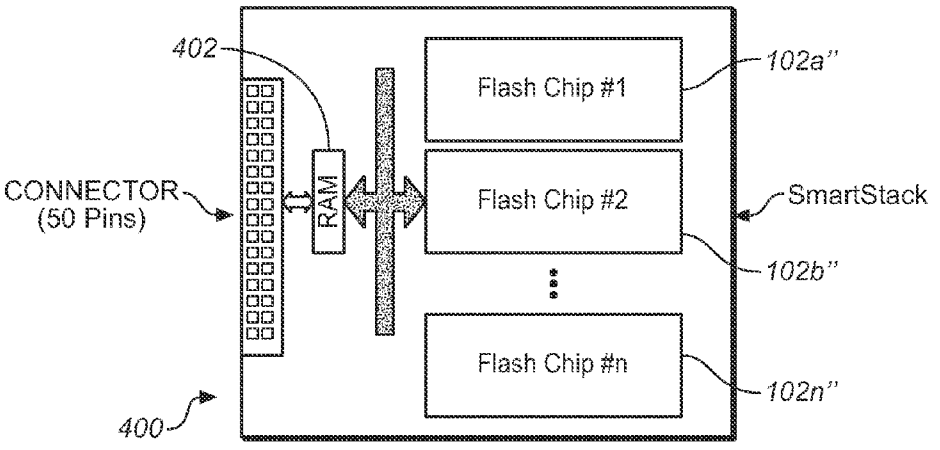

FIG. 7

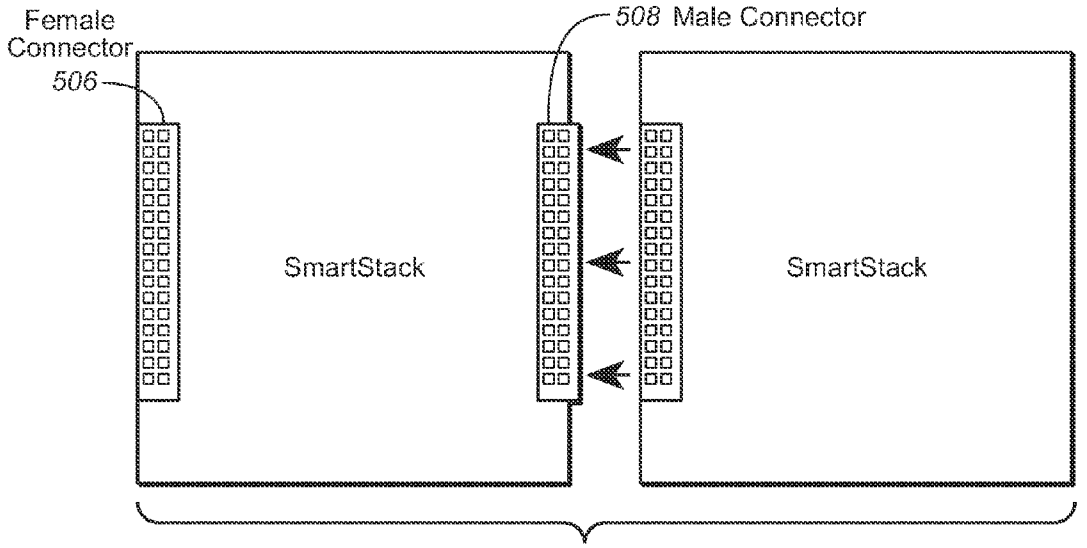
Female
Connector
506
508 Male Connector
SmartStack
SmartStack

FIG. 8

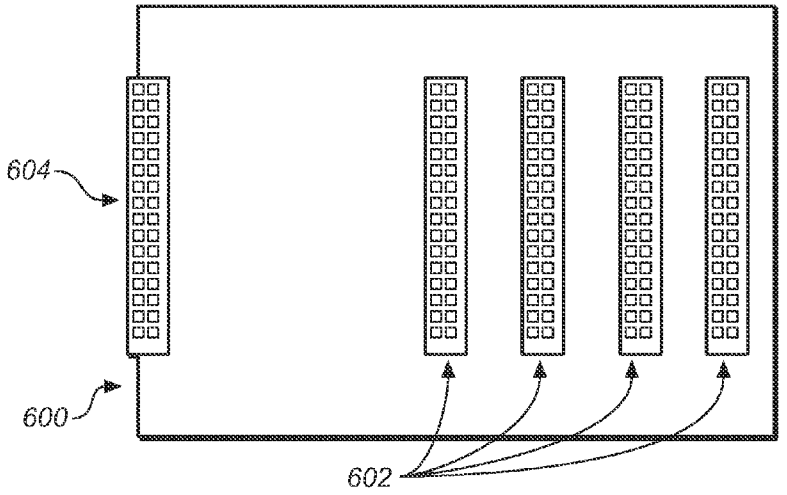
604
600
602

FIG. 9

MEMORY MODULE WHICH INCLUDES A FORM FACTOR CONNECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 10/063,021 filed Mar. 12, 2002, now U.S. Pat. No. 7,252,240, which is a continuation-in-part of U.S. patent application Ser. No. 09/610,904 filed Jul. 6, 2000, now U.S. Pat. No. 6,438,638, the disclosures of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates generally to memory modules and more particularly to a memory module which is coupled via a single connector.

BACKGROUND OF THE INVENTION

It is known that flash media is utilized in a variety of environments. Heretofore, the flash media is provided as a separate media to a device. In so doing, an array of different types of modules must be provided to allow for a connection to a device such as a digital camera, MP3 player or flash reader. It is desirable to provide a memory module that could be utilized with a variety of devices. The memory module must be compatible with existing standards and be capable of operating as a module.

Accordingly, what is needed is a system and method for providing a plurality of memories to such a device without requiring multiple connectors or a controller within the memory module. The system should be cost effective, a simple modification and easily implementable into an existing device. The present invention addresses such a need.

SUMMARY OF THE INVENTION

A plurality of flash media are coupled to a single form factor connector to provide a module, i.e., referred to as a SmartStack module, that can be coupled directly to a SmartStack enabled device. The SmartStack module does not include a controller and is controlled from the host side. The form factor connector would typically be a CompactFlash (CF) form factor or other form factors that are used in a variety of devices. The SmartStack memory module in a preferred embodiment includes a write protect switch that will allow for certain portions of the memory within the SmartStack module not to be written to. In addition, a portion of the flash memory will be allocated to the secure area for storing information to implement various forms of security. Another portion of the flash memory is allocated to store optional biometric information such as a user's fingerprint or retinal scan information, etc.

In a preferred embodiment, the SmartStack module is a flash memory card in a CF Type I or II format. The card will not be compatible with CF readers, but will be compatible with SmartStack readers. Larger memory sizes will be available as larger flash memory chips become available. Finally, the SmartStack module will include a write protect switch.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a SmartStack module.

FIG. **2** illustrates examples of the kinds of applications that can utilize SmartStack modules, such as a flash reader, digital camera or MP3 player.

FIG. **3** is a table which illustrates how a particular card will be detected by a device.

FIG. **4** is a table that illustrates addressing of the SmartStack module.

FIG. **4**A is a table that illustrates the relationship between the SmartStack module address lines and their equivalent pins on a CompactFlash card.

FIG. **5** is a table which illustrates the setting of a secure area of data for the SmartStack module.

FIG. **6** illustrates the SmartStack module which includes the write protect, security area and biometric area.

FIG. **7** illustrates adding RAM to SmartStack module to improve performance.

FIG. **8** illustrates daisy chaining a plurality of SmartStack modules in accordance with the present invention. FIG. **9** illustrates a SmartStack module which is an expansion bay.

DETAILED DESCRIPTION

The present invention relates generally to memory modules and more particularly to a memory module which is coupled via a single connector. The following description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment and the generic principles and features described herein will be readily apparent to those skilled in the art. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

A plurality of flash media are coupled to a single form factor connector to provide a module, i.e., referred to as a SmartStack module, that can be coupled directly to the device. The SmartStack module does not include a controller and is controlled from the host side. The form factor connector would typically be a CompactFlash (CF) form factor or some other form factor that are used in a variety of devices. The SmartStack memory module in a preferred embodiment includes a write protect switch that will allow for certain portions of the memory within the SmartStack module not to be written to. In addition, a portion of the flash memory will be allocated to the secure area for storing information to implement various forms of security. Another portion of the flash memory is allocated to store optional biometric information such as a user's fingerprint or retinal scan information, etc.

To more fully describe the present invention, refer now to the following description in conjunction with accompanying figures. FIG. **1** illustrates a SmartStack module **100**. The SmartStack module **100** comprises a plurality of memory devices (i.e., flash chips **102***a*, **102***b* through **102***n*) coupled to a connector **104**. In a preferred embodiment, the flash chips are coupled together such that there is redundancy for each section.

In a preferred embodiment the SmartStack module would have the same form factor as a CompactFlash (CF) card. The module could then be plugged into any CF slot. FIG. **2** illustrates examples of the kinds of applications that can utilize the SmartStack module **100**, such as a flash reader **202**, digital camera **204** or MP3 player **206**. In a preferred embodiment, only SmartStack module **202** based CF readers can read/write to SmartStack media, and inserting a SmartStack module into standard CF readers will not damage the SmartStack. As is seen, the SmartStack module does not include a controller

and is controlled from the host side. Since the module itself is devoid of any controller it can be expanded easily to add additional memory.

Card Detection

FIG. **3** is a table which illustrates how a particular card will be detected by a device. In this embodiment, when the SmartStack module (i.e., SmartStack NAND or SmartStack NOR) is plugged into the slot, the card detect pins (CD**1** and CD**2**) will be low. For compatibility with a device that can read a SmartStack module card, the card enable pins (CE**1** and CE**2**) will also be low. As is also seen, the other memory modules will have a different pin configuration for detection.

Addressing

FIG. **4** is a table which illustrates addressing of the SmartStack module. In a preferred embodiment, the SmartStack module will be programmed in a manner that is similar to a conventional memory module. The only difference will be the chip selects.

FIG. **4**A illustrates the relationship between the SmartStack module address lines (S**0** . . . S**3**) and their equivalent pins in a CompactFlash card.

Security and Biometric Information

FIG. **5** illustrates a SmartStack module **300** which includes the write protect mechanism **302**, security area **304** and biometric area **306**. The write protect mechanism can be locked or unlocked to allow for writing to the module. The write protect mechanism in a preferred embodiment may be read by software to prevent writing in the user area. It may be necessary to allocate space for security and biometric on each of the individual flash media, in which case the same table will be used to create this information. As is seen in this embodiment, the biometric area **304** and secure area **306** are allocated on **102***a*'. One of ordinary skill in the art recognizes that the areas **302** and **304** could be located in any or all of the flash chips **102***a*'-**102***n*' and that would be within the spirit and scope of the present invention.

FIG. **6** is a table which illustrates the setting of a secure area of data for the SmartStack module. For providing a secure area in the SmartStack module, in a preferred embodiment the following method will be followed: the first two bytes, byte **0** and byte **1**, will be set to C**3** B**6**. The next byte, byte **2**, defines the function. In addition, byte **5** (block status flag) will always be set to 0xF0 (or 0x0F) to indicate a failed block so that an operating system or firmware will not write over it accidentally.

An additional improvement for performance would be to add random access memory (RAM) to the stack. FIG. **7** illustrates adding a RAM **402** to SmartStack module **400** to improve performance. By adding the RAM **402** to the module **400**, data can be cached thereto thereby allowing for faster access to data in the module.

Additionally the SmartStack module can be designed to function like daughter boards on a base board so the capacity can be modularly increased. The SmartStack module can also be designed such that you can plug one card at the end of the previous one to form a chain (or daisy chain).

FIG. **8** illustrates daisy-chaining a plurality of SmartStack modules **500** and **502** in accordance with the present invention. Accordingly, in this embodiment, one SmartStack module **500** would include a female connector **506** on one end and a male (expansion port) connector **508** on the other to allow more cards to be plugged in. In an alternate embodiment, the expansion card can be itself devised to have several expansion ports (female connector) into which users can plug in SmartStack modules. The SmartStack module can optionally enable the user to have the capability of being able to review the pictures before committing it (saving it) to the flash media itself.

FIG. **9** illustrates a SmartStack module **600** which is an expansion bay. In this embodiment, additional SmartStack modules can be plugged into male connection slots **602** and the female connection **604** would connect to a SmartStack enabled CompactFlash Host.

Although the present invention has been described in accordance with the embodiments shown, one of ordinary skill in the art will readily recognize that there could be variations to the embodiments and those variations would be within the spirit and scope of the present invention. Accordingly, many modifications may be made by one of ordinary skill in the art without departing from the spirit and scope of the appended claims.

The invention claimed is:

1. A memory module, comprising:

a memory residing at the memory module that is to be controlled by a controller on a separate device; and

a connector to interface with the separate device, the connector comprising a pin configuration to identify to the separate device to use the controller of the separate device to control the memory of the memory module;

wherein the memory module has no controller within the module; and

wherein the pin configuration comprises a first card enable pin and a second card enable pin, the first and second card enable pins are to be low to indicate to the separate device that the memory module has no controller.

2. The memory module of claim **1**, further comprising a second connector to interface with a second memory module having one or more memory.

3. The memory module of claim **1**, wherein the connector is configured to interface with a plurality of types of devices.

4. The memory module of claim **1**, wherein the memory has a security information area.

5. The memory module of claim **1**, wherein the memory has a biometric information area.

6. The memory module of claim **1**, wherein the memory comprises a flash memory.

7. The memory module of claim **3**, wherein the connector is configured to interface with at least one of a group consisting of a Compact Flash, a Secure Digital (SD) card, a Multi-Media Card (MMC), and a Memory Stick.

8. The memory module of claim **1**, further comprising a random access memory (RAM) coupled with the memory.

9. The memory module of claim **8**, wherein the RAM is coupled between the connector and the memory, and the RAM comprises a cache memory.

10. The memory module of claim **1**, further comprising a plurality of connectors, the plurality of connectors to interface with a plurality of memory modules.

11. The memory module of claim **1**, wherein the separate device is at least one of a digital camera, a portable music player, a personal computer (PC), a flash memory reader, a personal digital assistant (PDA), or a device using removable memory.

12. The memory module of claim **8**, wherein a user can review content stored in the RAM before the content is written to the memory.

13. A system comprising:

a host device having a controller; and

a memory module, external to the device, the module having a memory that is to be controlled by the controller on the device, and the module having a connector to inter-

face with the host device, wherein the connector includes a pin configuration; and

wherein the pin configuration comprises a first card enable pin and a second card enable pin, the first and second card enable pins are to be low to indicate to the host device to use the controller of the host device to control the memory.

14. The system of claim **13**, further comprising a second connector to interface with a second memory module having one or more memory.

15. The system of claim **13**, wherein the memory module has no controller within the module.

16. The system of claim **13**, wherein the connector is configured to interface with a plurality of types of host devices.

17. A memory module, comprising:

at least one memory that is to be controlled by a controller on a separate host device; and

means for interfacing with the host device, wherein the means for interfacing comprises a pin configuration to identify that the at least one memory is to be controlled from the host side; and

wherein the pin configuration comprises a first card enable pin and a second card enable pin, the first and second card enable pins are to be low to indicate to the host device to use the controller of the host device to control the at least one memory.

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